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Do Government Loan Guarantees Lower, Or Raise, Banks' Non-Guaranteed Lending? Evidence from Japanese Banks[1]

James A. Wilcox
Haas School of Business
University of California, Berkeley
Berkeley, CA 94720

and

Yukihiro Yasuda[2]
Faculty of Business Administration
Tokyo Keizai University
and
Haas School of Business
University of California, Berkeley
Berkeley, CA 94720

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[2] Corresponding address: 1-7-34 Minami, Kokubunji, Tokyo, 185-8502 Japan. Tel/Fax: +81-042-3287876. E-mail:yyasuda@tku.ac.jp

**Do Government Loan Guarantees Lower,
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Evidence From Japanese Banks**

James A. Wilcox and Yukihiro Yasuda

Abstract

Concerns in the late 1990s about declining flows of bank credit and their adverse repercussions on the macroeconomy led the central government in Japan to vastly increase its already considerable supply of guarantees for bank loans made to small businesses. To date, there is little evidence to support the notion that total bank lending, or even total lending to small and medium-size enterprises (SMEs), was raised by the loan guarantee programs in Japan.

Our model and estimates suggest that loan guarantees, particularly during a time when many borrowers are in severe distress, may well be expected to raise non-guaranteed lending by sizable amounts. Coupled with additional guaranteed lending, our model and estimates indicate that total bank loans rose with, and more than, the supply of loan guarantees.

Under what we regard as plausible values for various parameters, the model suggests that a bank might extend from 1-6 units more of non-guaranteed loans to a borrower that got an additional guaranteed loan from that same bank. Thus, the guarantee program offers the potential for considerably raising non-guaranteed, as well as guaranteed, business loans, without raising banks' loss-given-defaults (LGDs). The model also shows that a bank's supply of non-guaranteed loans, per additional dollar of guaranteed loans, might well rise as borrowers become more distressed.

For the very important, very large, "city banks," loans made to small and large borrowers each rose. SME loans rose by about 3 times more (and perhaps more than that) than the increases in guaranteed bank loans to SMEs; loans to large businesses may also have risen more than guaranteed SME loans. At regional banks, the estimated effects are much smaller, typically indicating that total loans rose by only a fraction of the amounts of additional guaranteed loans. Thus, guaranteed loans acted more like substitutes for non-guaranteed loans at regional banks, while at city banks loan guarantees acted more like complements.

Guaranteed loans then might be regarded as having acted as a form of "synthetic capital" at city banks. In fact, we detected much stronger effects of the synthetic capital added by loan guarantees than we detected for either the actual reported levels of capital or the government injections of capital at city banks. At regional banks, total loans rose, but they rose by less than the additional amounts of guaranteed loans, indicating that non-guaranteed fell as additional loan guarantees were supplied.

Introduction

By the late 1990s, many Japanese banks and their borrowers were seriously troubled. It was commonly acknowledged, at least outside of Japan, that insolvencies were widespread among still-operating nonfinancial firms. A large cadre of so-called "zombie" businesses, which were generally agreed to be economically insolvent but still operating, and in many cases still borrowing from Japanese banks, emerged during this period. It was also recognized that the Japanese banking system had been severely weakened over the course of the 1990s. In connection with the weakened Japanese economy and banking system, in the late 1990s, both city and regional banks in Japan reduced their loans outstanding, both to small and large borrowers. Figures 1, 2, and 3 show that, at least from 1997 through 2002, bank loans from both city and regional banks declined considerably.

In light of the events unfolding around them at home, and in light of the growing consensus that U.S. banks had curtailed lending in response to capital pressures in the early 1990s, policymakers in Japan had reason to be concerned. Concerns in the late 1990s about declining flows of bank credit and their adverse repercussions on the macroeconomy then led the central government to vastly increase its already considerable supply of guarantees for bank loans made to small businesses.[3] To alleviate the downward pressure on bank lending, the Japanese government added the Special Credit Guaranteed Program (SCGP).

The SCGP expanded by a large amount the supply of guarantees for bank loans made to small and medium-sized enterprises (SMEs). The SCGP program supplied about an additional 30 trillion yen of loan guarantees from October 1998 through March 2001. As

[3] See Motonishi and Yoshikawa (1999) and Credit Guarantee Corporation (2006).

Figure 4 shows, the program raised the supply of the stock of loan guarantees by about 7 trillion yen, and raised the outstanding stock of loans guaranteed by about 30 percent. Figure 5 shows that, by the time the SCGP ended, more than one-third of SMEs and over one-tenth of total loans outstanding to SMEs were covered by the Japanese government's regular and special loan guarantee programs.

Few prior studies have estimated the effects of the loan guarantee programs in Japan. These prior studies provide limited and mixed evidence on the efficacy of the guarantee programs. Thus, to date, there is little evidence to support the notion that total bank lending was raised by the loan guarantee programs in Japan.

In contrast, our model and estimates suggest that loan guarantees, particularly during a time when many borrowers are in severe distress, may well be expected to raise lending by sizable amounts. We show conceptually that an increase in loan guarantees in the Japanese context might not only raise guaranteed lending, but might also lead to large increases in non-guaranteed lending.

A salient feature of the Japanese context is that all unsecured loans have equal priority in the event of default. Thus, when banks extended guaranteed loans to borrowers with pre-existing, non-guaranteed debt, the loan guarantee agency had no more claim on a defaulting borrower's assets than the other, unsecured creditors. (In an Appendix, we show that loans' being collateralized has relatively little effect on the implications of our model.) We show that, in the Japanese context of equal priority, because of their effects on LGD (i.e. loss (to banks) given default (of borrowers)), additional guaranteed loans enable banks to extend additional non-guaranteed loans to borrowers without raising banks' LGDs above levels that prevailed before the guaranteed and non-guaranteed loans

were added to borrowers' and banks' balance sheets.

Under what we regard as plausible values for various parameters, the model suggests that a bank might extend from 1-6 units more of non-guaranteed loans to a borrower that got an additional guaranteed loan from that same bank. Thus, the guarantee program offers the potential for considerably raising non-guaranteed as well as guaranteed business loans, without raising banks' LGDs. That said, neither our discussion nor our estimates directly address the ramifications of the Japanese loan guarantee programs on broader indicators, such as default rates, aggregate production, or social welfare.

The model also shows that a bank's supply of non-guaranteed loans, per additional dollar of guaranteed loans, might well rise as borrowers become more distressed. This provides some justification for Japan having added the SCGP when the plight of borrowers, and thus of their banks, had deteriorated so badly: the more "zombie"-like that borrowers were, the more non-guaranteed loans that their main bank might extend to them.

Our econometric results bear quite directly on the, perhaps surprisingly large, ‘‘complementarity" of guaranteed and non-guaranteed lending. We used annual data for 1996-2002 for (aggregate) bank loans to SMEs and for (aggregate) bank loans to large borrowers at individual banks in Japan. Our empirical specifications allowed for the effects on banks' loans outstanding of loan loss rates, of banks' capital positions, of government injections of capital into banks, and whether the individual bank was subject to Basel capital rules. We also allow for fixed effects across banks and for common, "national" effects across banks. We calculated instrumental-variables (IV) estimates in

order to cope with any endogenous feedback from bank lending back onto the amounts of individual banks' use of loan guarantees.

For the very important, very large, "city banks," loans made to small and large borrowers each rose. SME loans rose by about 2-3 times more (and perhaps more than that) than the increases in guaranteed bank loans to SMEs; loans to large businesses may also have risen more than guaranteed SME loans. At regional banks, the estimated effects are much smaller, typically indicating that total loans rose by only a fraction of the amounts of additional guaranteed loans. Thus, guaranteed loans acted more like substitutes for non-guaranteed loans, while at city banks loan guarantees acted more like complements. Guaranteed loans then might be regarded as having acted as a form of "synthetic capital" at city banks. In fact, we detected quite strong effects of the synthetic capital added by loan guarantees.

At regional banks, total loans rose, but they rose by less than the additional amounts of guaranteed loans, indicating that non-guaranteed fell as additional loan guarantees were supplied.

In conjunction with our estimating the effects of loan guarantees, we also estimated the effects on banks' lending of their reported, or measured, capital levels and of the injections of capital that they received from the Japanese government. Around the same time that the SCGP was operating, the central government of Japan injected large volumes of capital into some banks, especially the large, "city banks". These capital injections were large enough to raise reported aggregate bank capital by over nine trillion yen, or about two percentage points of total assets at city banks. (See figures 6 and 8.)

Because the government recorded contemporaneously how much capital it

injected, bank by bank, via its purchases of banks' securities, we regard the capital injections as being more accurately measured than the otherwise reported stock of capital, whose magnitudes depend on the banks' reports of the magnitudes of their reported assets after subtractions of charged-off and otherwise depleted-value loans. Although our estimates generally did not detect economically or statistically significant effects of their reported capital levels on bank loans, our estimates did detect much larger and more significant effects of the injected capital on bank loans during this period.

I. Institutional and Historical Background

The Bank Credit Guarantee System in Japan

Guaranteeing of bank loans made to SMEs has a long history in Japan. The size of the program historically reflects the government's willingness to support lending to smaller businesses. The Japanese Credit Guarantee System (CGS) was established in 1937. The CGS consists of 52 Credit Guarantee Corporations (CGCs), each of which guarantees bank loans made to SMEs. The public status of the CGS in its being backed by the central government was conferred in 1953 by the Credit Guarantee Corporation Law.[4]

Several features of the Japanese CGS are worth noting. First, by the end of fiscal year 2005, CGCs had outstanding liabilities of 28.7 trillion yen. That is, loans with book values totaling 28.7 trillion yen carried guarantees from the CGS. Second, in 2005, almost half of all SMEs had guaranteed loans. Third, the share of loans that were guaranteed was very large: About 40 percent of bank loans made to SMEs were covered by the CGS. Fourth, about 10 percent of the total yen value of bank loans to SMEs was covered by CGS loan guarantees. And, fifth, about 2/3 of SMEs had less than half of their

[4] See Credit Guarantee Corporation (2006).

loans guaranteed.[5]

In addition, the Japanese CGS is relatively unusual, and perhaps unique, in that its loan guarantees cover 100 percent of the losses (to banks) engendered by loan defaults. Therefore, banks bear none of the credit risks associated with the guaranteed loans that they extend to SMEs. Further, SMEs that obtain guaranteed loans via the CGS pay a fixed premium, as a percent of the book value of the loan, of 1.35 percent for uncollateralized loans and a fixed premium of 1.25 percent for collateralized loans, regardless of the default-related risks of the loans.

The role and relevance of the CGS expanded as the economy and the banking sector contracted during the 1990s. As the enormous, continuing flow of loan losses reduced their capital ratios, Japanese banks apparently reduced their supplies of bank credit to business borrowers. To help alleviate the resulting credit crunch in the late 1990s, the Japanese government introduced the Special Guarantee System for the Financial Stabilization of Small Businesses. This fillip to the preexisting system, which we refer to as the Special Credit Guarantee Program, or SCGP, granted loan guarantees from October 1998 through March 2001. The authorized ceiling on the stock of additional guarantees was initially set at 20 trillion yen, but the ceiling was then raised to 30 trillion yen in 1999, where it remained. (The ratio of guaranteed to total SME loan balances for this period are plotted in Figure 5. The payout ratio, the ratio of losses to the government due to its loan guarantees to guaranteed loans, is plotted in Figure 7.)

The SCGP differed somewhat from the long-running loan guarantee programs in Japan. By comparison, the criteria used by the SCGP for granting guarantees were much less strict. An application from an SME for a loan guarantee, which typically was

[5] See Table 3 for some of these data.

shepherded through the process by a borrower's bank, was in principle accepted unless the borrower was on a "negative list" (e.g., it had a tax delinquency, its books documented negative net worth, it had already defaulted on bank loans, etc.).

The outstanding stock of loan guarantees, i.e., the volume of loans that were guaranteed by the CGCs, greatly increased starting in 1998. The stock then gradually declined after the initial burst of guarantees were approved, when the ensuing flow of loan guarantees was smaller than the sum of the volumes of guaranteed loans that were repaid and of defaulted loans.

"Asset Substitution"

Under the Basel Accord, Japanese banking regulators purportedly required their internationally-active banks to maintain their risk-weighted capital ratios at least at 8 percent. Domestic-only banks faced a 4 percent minimum capital requirement. Because loan losses had been so severe through the 1990s, many Japanese banks had difficulty meeting the capital minimums. One way to boost their capital ratios was to reduce balances of loans, such as non-guaranteed loans, that carried 100 percent risk weights. In practice, doing so brought considerable criticism.

An alternative way to help satisfy pressing minimum Basel capital ratios was to refinance existing, non-guaranteed loans with guaranteed loans, because the risk weight of government-guaranteed loans was a mere 10 percent. In effect, adding a guarantee to a loan reduced its effective capital requirement by 90 percent. The introduction of the SCGP might have given Japanese banks the opportunity to substitute guaranteed for non-guaranteed loans.

The SCGP offered not only lower capital requirements. Of course, it also lowered credit risk to the bank. The SCGP was especially generous to banks and borrowers in that it covered 100 percent of the losses associated with default by the borrower. Thus, capital and credit provided Japanese banks with strong incentives to refinance their pre-existing loans to SMEs that had become financially distressed with new loans that were guaranteed under the SCGP. To the extent that such substitutions occurred, the net effects of this aspect of the SCGP on total bank loans outstanding would be tempered, or perhaps even completely negated.

Government Injections of Capital into Japanese Banks

Unrelated to the SCGP, but surely related to the sorry state of the Japanese macroeconomy and its banking sector at the end of the 1990s, the Japanese central government injected 1.8 trillion yen of public funds as capital into major banks in March 1998. This injection mainly took the form of subordinated loans from the government to the banks. Carried out via the Financial Function Stabilization Law of February 1998, these injections into banks counted as additions to banks' regulatory capital.

The Japanese government introduced another bank recapitalization program in October 1998. This program enabled weak but technically solvent banks to receive additional public funds that could also be counted as capital. This recapitalization program was initiated by the Financial Early Strengthen Law, which set up a Financial Revitalization Committee to oversee the restructuring process in recapitalized banks. Fifteen major banks applied for 7.5 trillion yen of additional capital funding in March 1999. To obtain the funds, each bank issued preferred stock to the Deposit Insurance Corporation and/or issued subordinated loans or subordinated debt to the Deposit

Insurance Corporation. Participation in the program required a bank to submit a Business Revitalization Plan to the Financial Revitalization Committee. Participation also required that a bank hit several targets, such as meetings minimum Basel capital ratios, increased lending to SMEs, reduced staffing levels, and so on.[6]

II. Literature Review

Few prior studies have estimated the effects of government loan guarantees on lending. Holding constant a number of financial and economic factors, Hancock, Peek and Wilcox (2006) conclude that, for the United States, SBA loan guarantees tended to produce net increases in bank loans made to small businesses.

Matsuura and Takezawa (2001) conducted one of the first studies of the effects of Japanese government loan guarantees on bank lending. Based on a panel of annual data by prefecture for the fiscal years 1998 and 1999, they found no statistically significant effect of loan guarantees on total bank lending to SMEs.[7] One possibility is that, despite the cross-prefecture variations in their data, their having data for only the beginning of the SCGP period made it difficult to detect the effects, if any, of loan guarantees on lending to SMEs. Given that guaranteed SME lending did surely rise, the failure of total SME lending to rise suggests that non-guaranteed lending to SMEs actually declined.

Konishi and Hasebe (2002) then estimated essentially the same specifications that Matsuura and Takezawa had used over a longer sample period by including data through 2001. They also included in their data the lending done, in addition to that done by city and regional banks, by credit banks and credit cooperatives. Based on their panel of data (annually, by prefecture), they estimated an elasticity of total SME loans to guaranteed

[6] See Shimizu (2006).
[7] Matsuura and Takezawa (2001) did find that higher land prices stimulated lending and loan loss rates reduced lending.

SME loans of about three-quarters. Converting that estimated elasticity to units suggests that total lending to SMEs rose by a large multiple of the increase in guaranteed SME loans. For example, based on an estimated share of guaranteed SME loans in total SME loans of about 10 percent, their estimates suggest that each additional unit of guaranteed SME loans was associated with an increase of about 7 ½ units of total SME loans.

Sui (2004) used data for individual city and regional banks over a longer time period. Based on data for the 1990s, he found a very small elasticity (about 0.025) of total SME loans to guaranteed SME loans. That elasticity suggests that total SME loans rose by much less than the increase in guaranteed SME loans and that, as a result, non-guaranteed SME loans declined when guaranteed loans rose.

Thus, evidence from prior studies about the effects of Japanese guaranteed SME loans is limited and mixed: One study found very large effects at the prefecture level when credit banks and cooperatives were included, but another study found very small effects on the basis of individual bank data. To improve our understanding of the effects of loan guarantees on non-guaranteed SME lending, as well as the effects on lending to larger businesses, we use individual bank data for the entire period (and beyond) of the Special Credit Guarantee Program.

III. Loss Given Default, Guaranteed Loans, and Non-guaranteed Loans

Based on a simple specification of a borrower's balance sheet, in this section we show that a bank can reduce its LGD by increasing its guaranteed loans to a distressed borrower. Then we show the extent to which a bank can extend more non-guaranteed loans to the same borrower without increasing LGD when it is also extending more

guaranteed loans.[8]

Our analysis incorporates an important aspect of Japanese law and practice in the event that a borrower defaults--that the claims of banks and of the government loan guarantee agency tend all to be treated with equal priority.[9] Equal priority holds regardless of the identity of the lender and regardless of the order in which the loans were extended. (In an Appendix, we show that collateralization of loans has relatively little effect on the implications of our model.) Equal priority has important implications at the margin for the risks and returns of additional, non-guaranteed loans when banks also have granted guaranteed loans to a borrower.[10]

To start, suppose that a nonfinancial firm initially has assets with book value equal to 100, book value liabilities in the form of bank loans equal to 80, and positive net worth equal to +20. Then, suppose that the borrower becomes financially distressed, perhaps as a result of a serious decline in its sales, and the market value of its assets decline by 30 percent to 70. That leaves the distressed borrower with assets (a) that have a market value of 70, with (book and market value of) liabilities ( ) of 80, and therefore with net worth or equity, e, equal to -10:

$$a = l + e \implies e = a - l = 70 - 80 = -10$$

We suppose further that the borrower, despite its current condition and how it

[8] For simplicity, we assume that the borrower only has outstanding, prior and new loans from its "main bank." The results are similar if the borrower also has outstanding loans from another lender.

[9] We suppose that the government's loan guarantee agency, in the event of default, never loses more than the book value of the loan that it guaranteed and never loses less than zero.

[10] One way in which equal priority manifests itself is that defaults of presumably-negative-net-worth borrowers lead the guarantee agency to make a net contribution to proceeds received by the bank. If the bank's claim were subordinate to that of the guarantee agency, then the guarantor might contribute nothing in the event of default, thereby discouraging the bank not only from making additional non-guaranteed, but also guaranteed, loans to zombie businesses.

became insolvent (in the sense that its net worth is negative), has available to it some profitable projects. In particular, we assume that, for example, if the borrower acquires 10 units of additional funds it can invest in a project that offers an expected gross return, *R*, where $R \equiv (1+r) =$ 1.05, that is, it can expect to earn a 5 percent return on the project. Thus, although events have turned this business into a "zombie," we suppose that it now has profitable opportunities.[11]

We also assume that, if the borrower fails and therefore defaults on its loans, that the loss ratio on its assets is 5 percent: $\delta = 0.05$. Given that assets have already been marked down to their market value, this 5 percent loss can be regarded as the extra costs in the form of transactions or liquidation costs beyond those implied by the mark down of the book value of assets of, say 100, to their assumed market value of 70.

How much would the main bank lose if the borrower defaults before (B) it takes out a guaranteed loan? The loss (to the bank) given default (of the borrower), LGD^B, can be expressed as:

1) $$LGD^B = l - a(1-\delta) = l - (l+e)(1-\delta)$$

LGD is the amount of outstanding loans minus the amount recovered from the sale of the repossessed assets of the borrower (See also Figure 9-B). The first term on the right-hand-side is the amount of credit extended to the borrower, i.e., the size of the outstanding loan. The second term is the net amount that the main bank recovers in the event of default, the post-liquidation value of the borrower's assets.

[11] Zombie and even some solvent businesses might well have strong incentives to borrow even if they have available only negative NPV projects. Undertaking negative NPV projects might not only importantly affect LGD, but presumably would raise a bank's expected losses because of the effects of the project's raising the borrower's probability of default. We analyze only the case where the business has positive NPV projects.

How much would the main bank lose if the borrower defaults after (*A*) it receives a guaranteed loan from its main bank? In that case, LGD^A can be expressed as:

2) $$LGD^A = l + g - g - (a + Rg)(1-\delta)\frac{l}{l+g} = l - (l + e + Rg)(1-\delta)\frac{l}{l+g}$$

When the borrower has both non-guaranteed and guaranteed loans, then the total owed to the bank equals $(l + g)$. Regardless of whether the borrower defaults, the bank recovers g, the amount of the guaranteed loans (See also Figure 9-A). In addition, the main bank will share, with the government (in the person of the loan guarantee program) the value recovered by selling the repossessed assets of the borrower. In addition to the market value, a, of the assets that the borrower had prior to taking on the guaranteed loan, the borrower also has Rg units of assets that it received as the gross return on the g units of guaranteed loans that it took on during the period. If the borrower then defaults, under the equal priority rule, the bank's share of the market value that is recovered from the borrower's total assets is $l/(l + g)$, and the government's share is $g/(l + g)$. Thus, the bank's total recovery can be expressed as:

$$(l + e + Rg)(1-\delta)\frac{l}{l+g}$$

From the expressions above, we can determine that the bank's LGD^A falls as the volume of guaranteed loans, g, rises, if the net rate of return on the project, r, exceeds the ratio of (the market value of) net worth, e, to the prior, non-guaranteed loans:

3) $$\frac{\partial LGD^A}{\partial g} \le 0 \quad if \ r \ge \frac{e}{l} \text{ and } \frac{\partial LGD^A}{\partial g} > 0 \quad if \ r < \frac{e}{l}$$

An equivalent way to express this relation is:

4) $LGD^B \geq LGD^A \qquad \Leftrightarrow R \geq 1 + \frac{e}{l} \Leftrightarrow r \geq \frac{e}{l}$

Thus, the main bank can, perhaps not surprisingly, reduce the LGD associated with this borrower if $r > e/l$. One simple case in which this condition is satisfied is when net worth, *e*, is negative, as we have posited above. (One might argue that LGD is relevant primarily in the event that net worth is negative, i.e., when $e < 0$.) Note that, given an expected return on the additional project that is too low or equity that is too high, then it the LGD may actually rise as the borrower takes on more guaranteed loans. But, in the case at hand, where $e < 0$, the bank (quite apart from other considerations associated with its own condition), can reduce its LGD by extending guaranteed loans to distressed borrowers. Thus, banks have that incentive to offer guaranteed loans when the government offered fixed, under-priced loan guarantees. And, indeed, we observed that virtually the entire fixed supply of loan guarantees that was provided the government during this period was taken up.

The next question is what effect these guaranteed loans would be expected to have on non-guaranteed loans. Here we will demonstrate that a bank could hold the LGD associated with a given borrower constant if it extended both guaranteed loans and non-guaranteed loans. Recall the LGD for a bank that has extended a guaranteed loan to a borrower:

5) $LGD^A = l + g - g - (a + Rg)(1 - \delta)\frac{l}{l+g} = l - (l + e + Rg)(1 - \delta)\frac{l}{l+g}$

Totally differentiating LGD^A, we get:

$$dLGD^A = \left[\frac{\left(l^2 + 2gl\right)\left(1-(1-\delta)\right) + g^2 - (1-\delta)(e+Rg)g}{(l+g)^2}\right]dl - \left[(1-\delta)\frac{\left\{l^2(R-1) - el\right\}}{(l+g)^2}\right]dg$$

Setting $dLGD^A = 0$ produces:

6) $$\frac{dl}{dg}\Big|_{dLGD^A=0} = \frac{(1-\delta)\left\{l^2(R-1) - el\right\}}{\left(l^2 + 2gl\right)\left\{1-(1-\delta)\right\} + g^2 - (1-\delta)(e+Rg)g}$$

Thus, equation 7) shows the change in non-guaranteed loans, per unit of guaranteed loans, that would leave the bank with an unchanged LGD. That change is positive, i.e., $dl/dg > 0$, when the borrower is insolvent ($e < 0$). Borrower insolvency is a sufficient condition for the effect to be positive; it can also be positive even if the borrower is solvent ($e > 0$), depending on the values of other parameters.

An important factor in the magnitude, and even the sign, of the impact on non-guaranteed lending of additional loan guarantees is the economic condition of the borrower. As our model makes clear, the more negative the net worth or equity of the borrower, i.e., the more "zombie"-like the business is, the larger the complementarity between the guaranteed and non-guaranteed loans for an individual bank that keeps its LGD unchanged. The role of borrower distress then is vital in assessing the net effects of such loan guarantee programs, and thus, presumably, whether such programs are to be recommended as ongoing supports or primarily introduced as countercyclical measures. The model implies that, holding LGD constant, dl/dg rises as the condition of borrowers deteriorates and that dl/dg falls as borrowers rely more heavily on guaranteed loans.

Figure 10 plots the values for dl/dg as ϵ varies that are implied by equation 7) above, under the assumptions that l=80, g=10, R=1.05 (as well as for R=1.00 and for

R=0.95), and $\delta = 0.05$. Figure 10 shows that, for a wide range of values for net worth (ϵ), dl/dg is positive: If banks operate so as to hold LGD constant, then each additional unit of guaranteed lending brings forth a much larger increase in non-guaranteed lending.

Figure 10 also shows how much larger that response coefficient is as a borrower becomes more financially distressed. For example, given a project that offers R = 1.05, comparing a borrower with zero net worth with a borrower that is so severely distressed that ϵ= -40, Figure 10 shows that the response coefficient is positive and rises substantially, from about one to more than four.

Figure 11 shows the model's implications for the response coefficient to changes in the extent to which the borrower already has guaranteed loans, given the values of the parameters assumed above and values for R of 0.95, 1.00, and 1.05. In Figure 11, we see again that the implied responses are positive, are larger the better the investment returns (R), and decline considerably, from about three to about one, as g rises from zero toward 30 percent and more.

The model and discussion in this section proceeded on the supposition that a bank might be willing to make a package of additional guaranteed and non-guaranteed loans that would maintain the original value of that borrower's LGD. Perhaps not when the economy and banks were in more normal conditions, but perhaps during our sample period, Japanese banks might have faced various pressures, emanating, say, from the government or from the bank's social, cultural, and historical environment, that led banks to lend to a borrower as if they were maintaining a constant level of LGD.

An alternative model specification might have held constant expected loss (EL), which is the product of the LGD and the probability of default (PD). When the borrower

has profitable investment opportunities, then additional loans would likely lower the borrower's PD, and thus further lower the bank's EL. Then, a bank that was willing to lend to the extent that its EL was unchanged might well lend more than the model above indicates.

Yet another alternative is that, during the sample that we are considering, Japanese banks operated as if they were attempting to maximize expected (risk-adjusted) profits. Whether they did is difficult to determine, and perhaps difficult to support on the basis of their lending in the years before and after our sample period.

IV. Data

Sample

We use a panel dataset for individual, Japanese city and regional banks for the fiscal years 1995-2001.[12] City banks are commercial banks that are effectively national in that they are large banks that operated in the major cities of almost every prefecture.[13] Regional banks are generally smaller and typically operate in the major cities of a given prefecture. On average over our total sample period, for each year we had data for nine city banks and 122 regional banks.

Data for the volume of loans that are covered by loan guarantees were collected from the Annual Reports on Credit Insurance Statistics, which provide data for guarantees by individual bank for each year through fiscal year 2001. Our final sample contained 145 banks.[14] Data for GDP and land prices at the prefecture level were collected from SNA Statistics. Data for the amounts of public funds injected into individual banks as bank capital were collected from the Financial Service Agency. The remaining data were

[12] Our sample included neither credit banks nor credit cooperatives.
[13] There are 47 prefectures in Japan.
[14] When a bank merged with other banks, we count it as a different bank.

collected from the Nikkei NEEDS database.

Data Perspectives

Table 1 shows descriptive statistics for the data for banks' assets, total loans, loans outstanding to small and medium-sized enterprises, loans outstanding to large businesses, amounts of guaranteed SME loans (CG), ratio of equity capital to total bank assets (EQCAPLEV), and losses reimbursed by the government loan guarantee agency to banks (PG). The statistics are shown for the entire period and earlier and later subperiods. Table 2 shows data for the same variables for regional banks. Table 3 shows the extent to which SMEs had loan guarantees, classified by borrowers' credit scores.

The figures provide an overview of some of the annual data for 1996-2002 that we use for our regressions. Figure 1 plots total (outstanding nominal yen balances of) loans separately for city and for regional banks annually for the 1996-2002 period.[15] Loans at city banks declined substantially and quite consistently over this period. Indeed, total loans continued to decline considerably when the SCGP was introduced and continuing to grant loan guarantees, fiscal years 1999-2002. Declining, about 15 percent over the 1996-2002 period, total loans at city banks decline marginally slower during the SCGP period. Loans at regional banks also declined from 1996-2002, but by proportionally much smaller amounts.

Figure 2 plots the same data for loans made to SMEs. Despite having many fewer total loans, regional banks had more SME loans than city banks did.
SME loans at city banks also declined dramatically from 1996 through 2002 and by

[15] Data in the figures refer to fiscal years. Japanese fiscal years begin in April of the calendar year. Fiscal year 2000, for example, starts at the beginning of the second quarter of 1999 (April 1999). For the variables used to produce the statistical tables, year 2002 refers to data for banks as of the end of March 2002 (which is the end of fiscal year 2001).

larger amounts than they did at regional banks. Notably, SME loans at city banks rose considerably in 2000, while changing little at regional banks. By 2002, however, SME loans at city banks had fallen dramatically back to their prior trend level.

Figure 3 plots loan balances for loans made to larger borrowers, calculated as the difference between the series plotted in Figures 1 and 2. A similar pattern emerges. Loans to large borrowers at city banks declined by over 10 percent over the entire period, while large loans changed little and perhaps even increased at regional banks. Thus, these data hardly point to the additional loan guarantees as having stimulated total lending or even lending to SMEs, at either city or at regional banks.

Figure 4 plots the outstanding balances of SME loans that carried government guarantees at city and at regional banks annually over the 1996-2002 period. While guaranteed loans initially rose by upwards of 20 percent at city banks after the introduction of the SCGP, by 2002 balances on guaranteed (SME) loans at city banks were somewhat lower than they had been before the inception in 1999 of the SCGP. In contrast, at regional banks, guaranteed loans spiked up by more than one-third and stayed at about that level through 2002.

Figure 5 displays another view of the amount of guaranteed loans; Figure 5 plots the ratio of guaranteed to total SME loans. At city banks, the ratio initially rises noticeably and then reverts toward its initial value of about 10 percent. At regional banks, again by contrast, the ratio rises by nearly 50 percent and remains near that level through 2002, the year after the SCGP finished guaranteeing additional loans. (The special program guaranteed no more loans after early 2001.) Thus, the time series plots in Figures 1-5 suggest that the effects of the SCGP might have been larger on regional than

on city banks. Of course, so far, we have not controlled for any of the other, relevant factors that might affect loans to SMEs and large borrowers.

Figure 6 plots the reported (equity) capital (to total, unweighted assets) ratios of city and of regional banks for the 1996-2002 period. By the end of the 1990s, loan losses had decimated capital ratios at Japanese banks, especially at city banks. The (explicit) injections of capital into city banks by the central government then boosted capital by a small amount in 1998 and again, but by a much smaller amount, in 1999. Despite shrinking their assets, renewed losses after 2000 again pulled their ratios down. Capital ratios at regional banks also rose starting in 1999 but fell back by a relatively small amount in 2002. Figure 8 plots the aggregate, explicit capital injections made into city banks (as a share of total bank assets. The effect of the capital injections in 1998 and 1999 was to raise the aggregate capital ratio of city banks by about two full percentage points.

Figure 7 shows how much the loan guarantee agencies paid out to banks on guaranteed loans that defaulted. The Figure plots the losses as a percentage of guaranteed loans for each year during the 1996-2002 period. At city banks, the ratio was already trending upward when the Special program was initiated. In the years after the SCGP was in operation, the payout ratio rose markedly, both at city banks and at regional banks.

Tables 1 and 2 continue our overview of the data, presenting descriptive statistics for city and for regional banks, respectively, for the entire 1996-2002 period and for two sub-periods: the years 1996-1998, which covers the period before the introduction of the Special Credit Guarantee Program (SCGP), and for the years 1999-2002, the period when the SCGP was guaranteeing SME loans.

Column 4 presents t-statistics that test whether the means differed over the earlier and later sub-periods. At city banks, although total and large loans were detectably lower after 1998, total assets and total SME (i.e., small) loans were not detectably lower. One reason may have been that guaranteed SME loans were higher—but not statistically significantly so, in the later period. At regional banks, although guaranteed SME loans were clearly higher on average in the later period, total small loans were actually lower in the later period. (Compare row 4 with row 2.) Despite large loans being slightly higher in the later period, the decline in small loans was so drastic that total loans actually declined. Thus, the data in tables 1 and 2 provide little reason to expect that the SCGP, or any other developments in the later period, raised lending to SMEs, much less to large borrowers.

Estimation

To investigate the effects of the SCGP and other factors on bank loans, we applied panel data estimation techniques to our standard specification for lending at city banks:

7)
$$LOAN_{i,t} = \alpha_0 + \alpha_1 CG_{i,t} + \alpha_2 EQCAPLEV_{i,t} + \alpha_3 BASEL_{i,t} + \alpha_4 CAPINJECT_{i,t} + \alpha_5 PG_{i,t} + \alpha_6 ASSETS_{i,t} + \varepsilon_{i,t}$$

The dependent variable is the stock of loans outstanding at bank i at time t. We use three measures of loans: Total loans (TL), small loans (SL), and large loans (OL), where OL (for "other loans") is calculated as the difference between total loans and small loans.[16]

We define the independent variables of Equation 8) as follows:

CG: Stock of loan guarantees, millions of yen at end of fiscal year t. [17]

EQCAPLEV: Book value of equity, millions of yen at end of fiscal year t.

[16] We refer to loans made to SMEs as small loans, even though we have no information about the sizes of loans. Banks report loans by size of borrower, but not by size of loan.
[17] *CG* includes both the guarantees made under the SCGP and other, pre-existing guarantee programs.

BASEL: Dummy variable=1 for a bank is subject to Basel standards, zero otherwise.

CAPINJECT: Public injection of capital, millions of yen at end of fiscal year t.

PG: Payouts by loan guarantee agencies, millions of yen in year t.

While most city banks received them, relatively few (16 out of 117) regional banks received capital injections. Typically, the regional banks that did receive capital injections were those that were themselves in especially severe financial distress—so severe that most of them soon merged into other banks, had just emerged from a failed bank, or actually failed. Partly because their conditions were especially dire, their reported financial statements may not have accurately reflected their financial conditions contemporaneously. That may have been why we estimated significant negative effects on their lending of additional capital injections. Those estimates in fact may have resulted from that sort of measurement error in their reported capital. In light of the tendency to have capital injected selectively at the most impaired regional banks, we omitted *CAPINJECT* from the specification that we used for regional banks.

Since they operated typically within a single prefecture rather than nationally, to the specification that we used for regional banks, we added a variable that was available annually and that differed across regions, *BUSLAND*, which is the price index for commercial land. In the regional bank regressions, we also included *GDP*, which measures economic activity in the prefecture relevant to each regional bank.

National *GDP* was never significant in the regressions based on city bank data. Although a national measure of *BUSLAND* was available, rather than include national *BUSLAND* and/or national *GDP*, in each of the city bank regressions, we included the more flexible year dummies, which would in any event have been perfectly collinear with

other national measures. We do not show the estimated coefficients for the year dummies in the regression tables below.

V. Empirical Findings

In this section, we present the results of estimating the effects on bank lending of loan guarantees, bank capital, and payouts on loan guarantees. We present results based on data for individual city banks and separately for regional banks, based on the entire period and for sub-periods, and based on an instrumental-variables (IV) estimation method. Each of the variables, except for the dummy variables, was standardized by dividing it by the total assets of each bank for each year. Our full sample period covered the 1996-2002 period.

Due either to lack of data availability or of the authors' imaginations, as is always the case in such specifications, some important bank-specific variables doubtless were omitted from the general specifications that we used. Allowing for fixed and year effects is one way to reduce the deleterious effects on the estimated effects of included variables of such omissions. To reduce the deleterious effects of such omissions in Tables 4, 5, and 6, each specification included fixed-effects and year dummies, the former to allow for persistent, unmeasurable differences across individual banks and the latter to allow for the "national" effects that were common across banks but differed across years. We do not report the effects of the bank-specific or year dummies that we included in each specification.

Estimation via Instrumental Variables

The results in Tables 4-6 are based on instrumental-variables (IV) estimation

method.[18] At an individual bank, stronger loan demand might lead simultaneously to more of both guaranteed and non-guaranteed loans. Suppose, for example, that the bank-specific loan officers or business borrowers at a bank lead to stronger demand for bank loans. As a result, guaranteed and non-guaranteed loans might rise in tandem, not because an increase in the government's supply of loan guarantees, but rather because an omitted factor is pulling up both types of loans. In that case, the amount of guaranteed loans, *CG*, should be treated as endogenous. Because the resulting amount of guaranteed loans at each bank in each year (*CG*) in that case would be correlated with the error term in the loan equation, we instrumented *CG*.

As instruments, we used the following variables for each specification in Tables 4-6: the one-year lag of the dependent variable, the one-year lag of *CG* itself, and current and one-year lags of each of the right-hand-side variables other than *CG*. (Our using lagged variables as instruments precluded our calculating IV estimates based only on the subperiod prior to the advent of the Special Credit Guarantee Program.)

In addition, we also included an instrumental variable that measured how "guarantee intensive" each bank's loan portfolio had been before the advent of the SCGP and the amount of additional loan guarantees that were supplied "exogenously" by the SCGP. We calculated that instrumental variable as the product of (1) the shares of the total national amount of SME loan guarantees outstanding in Japan that each bank had at the beginning of the entire sample period (1996:03) and (2) an estimate of the

[18] We also calculated random-effects estimates for the sake of completeness and comparison. The structure of our data precluded our including a dummy for every year in some of the regression in Tables 4 and 6. That meant that we could not perform Hausman tests of fixed-effects versus random-effects specifications that included year dummies. Hausman tests based on specifications that omitted year dummies, however, tended to favor the fixed-effects over the random-effects specifications for both city and for regional banks.

(exogenous) annual total national amount of SME loan guarantees in Japan extended under the SCGP based on its legislative mandate. Next we describe how we estimated this amount for each year since the inception of the SCGP through FY2001.

Figure 12 displays the legislated cap on the total gross stock (i.e., the cumulated gross flows of additional SME loan guarantees) available under the SCGP. After becoming available for the first time during FY1998, loan guarantees under the SCGP were capped initially at 20 trillion yen. The cap on the total gross stock was raised to 30 trillion yen during FY2000. Many of the guaranteed loans, like non-guaranteed loans, were of relatively short maturities. Under the rules of the SCGP, which specified a cap on the cumulated gross flow of loan guarantees, rolling over maturing short-term loans used more of the available supply of loan guarantees than did a single, longer-term guaranteed loan. As a result of the short effective loan maturities, the outstanding stock of guaranteed loans made under the SCGP (and under the standard guarantee program) was typically far below the total gross stock of guarantees that had been issued. Based on the annual gross flows of new guarantees and the resulting net stock of guaranteed loans, we estimated that the “depreciation”, or “run-off”, rate for guaranteed loans was about 50 percent annually.

We used a 50 percent depreciation rate, the fact that the SCGP was instituted part way through FY1998, and the legislated caps on the SCGP to estimate the annual amounts of the maximum total national supply of loan guarantees under the SCGP. The resulting values for this second term in the instrumental variable for the exogenous amount of loan guarantees associated with each bank are shown as IV0 in Figure 12. IV0 reflects the timing and sizes of legislative changes to the SCGP and our estimate that

previously-granted guaranteed loans tended to "run-off" at a rate of about 50 percent annually. (Figure 12 also displays the amounts of another estimate of the exogenously supplied loan guarantees, IV1, which was arbitrarily set to equal 10, 15, 20, and then 10 trillion yen. Results (not shown) based on IV1 differed only slightly from those based on IV0.)

Results for City Banks

Table 4 presents the IV estimates for our panel data for city banks for each sample period. The full-sample results are presented in columns 1-3. Row 1 shows the estimated effects of an additional unit of guaranteed (SME) loans, CG: Total loans rose by a statistically and economically significant amount: 2.906. (t-statistics are shown in parentheses under each coefficient in Tables 4-6.) The magnitude of this coefficient estimate is representative of many of the estimated effects for city banks that follow in Tables 4 and 5.

The size of the estimated effect suggests that, for each additional unit of guaranteed loan, a city bank tended to extend nearly 3 units more of loans. Columns 2 and 3 indicate that about 60 percent of that effect consisted of an increase of about 1.8 units of SME loans and the remaining 40 percent consisted of an increase of about 1.2 units of large loans.[19] The effect on small loans was statistically significant only at the 10 percent level (t=1.90); the effect on large loans was statistically insignificant (t=1.15).

Recall the loan guarantees included in the variable CG applied directly only to SME loans. A bank that sought to maintain the LGD of its entire portfolio, however,

[19] We refer to loans made to large borrowers, that is those that are not SMEs, as large loans. Of course, large borrowers might have small loans, and vice versa, but in general we expect loan and borrower size to be quite highly but not perfectly correlated. We don't have data on the size of the loans themselves.

might simultaneously extend more guaranteed loans to SMEs and non-guaranteed loans to larger borrowers. In column 3 of row 1, however, we found an impressively large, but statistically insignificant effect on lending to larger bororowers.

As we move rightward across the columns of Table 4 and thereby to shorter sample periods, we see that the effects of guaranteed loans were even larger than in the full sample period, which differed in its inclusion of the year prior to the Special Credit Guarantee Program. In general, however, the effects were quite similar in the earlier and later sub-periods. One difference, however, was the larger size and (statistical) significance of the effect of *CG* in the later period. A larger coefficient in the later period would be consistent with borrowers' being more financially distressed in the later period and therefore, as Figure 10 depicted, responding more per unit of loan guarantee. And, in each subperiod, the effects on total and SME loans were large and statistically significant and the effects on loans to larger borrowers was quite large, but statistically insignificant.

The remaining rows of Table 4 show that the estimated effects of a number of control variables that we included to reduce the likelihood of important omitted variable bias.[20] Row 2 shows the estimated effects of a unit of (reported) equity capital on lending. In general, capital effects in Table 4 were estimated to be very small, insignificant, and occasionally negative. By contrast, in U.S. data for periods—such as the early 1990s—when banks were under capital pressure, estimates of similar specifications often were statistically significant and generally fell in a range, say, of 2-4. One possible reason that the estimated effects here were so low is "measurement error." The large, Japanese city banks generally have been thought to have under-stated loan losses (and thus over-stated

[20] Tables 4-6 follow a similar, but not identical, format. We include more controls for regional banks.

their capital) during the 1990s, and since. As a result, there has long been suspicion that the reported capital data for Japanese city banks during this sample period were not very accurate. Measurement errors of this sort might well have seriously biased downward our estimates.

Another capital variable, *CAPINJECT*, is the number of units of capital that the central government injected into each bank. Because the government (presumably very accurately) recorded how much capital it had just injected in the banks, the data for *CAPINJECT* are presumably much more reliable measures than those for *EQCAPLEV*. Accordingly, the estimated effects of *CAPINJECT*, shown in row 4, are generally much larger than those for *EQCAPLEV*, which are shown in row 2.

For the full sample period and for the subperiod that began in 1998, the both total and SME loans rose by about 3 units per unit of capital injection. (These estimates are close to the estimated capital effects reported by Peek and Rosengren (1998) and Hancock and Wilcox (1999). We cannot tell how much of the increase in SME loans resulted purely from economic incentives and how much (if any) resulted from, in conjunction with their getting publicly-funded capital injections, banks' feeling compelled by regulators, to increase their loans to SMEs in particular. We do note that banks were less likely to feel regulatory pressure to lend more to larger borrowers and that our estimated effects of *CAPINJECT* on loans to larger borrowers were economically and statistically insignificant.

Row 3 presents the estimated effects of the dummy variable that indicated whether each bank was subject to the Basel capital standards. Not all city banks were subject to the Basel standards later in our sample period, though all were early in the full

sample period. That some city banks shed their international operations in order to escape the Basel regulations enabled us to estimate the effect of *BASEL* for the later subperiod and for the entire period. Although none of these estimated effects were economically or statistically significant, the estimates in row 3 weakly suggest that Basel-constrained banks, ceteris paribus, might have made fewer total loans.

Row 5 presents the estimated effects associated with an additional unit of payout by the loan guarantee agency. We interpret this variable, *PG*, as an indicator of the extent of problem loans, not just of guaranteed loans but also of non-guaranteed loans. In row 5, for the total sample period, the estimated effect of *PG* was significantly negative for SME loans, but not for total or larger loans. Row 6 shows that the overall size of the bank, as measured by its asset size, quite consistently affected how much SME lending it did. As in the United States, the larger the bank, the smaller the share of its assets it held as SME loans.

As a robustness check, Table 5 repeats the specifications and samples used for Table 4, except that we excluded the *EQCAPLEV, BASEL* and the *PG* variables, which had typically were insignificant in Table 4. Not surprisingly perhaps, estimation of specifications that were truncated by excluding the those three control variables produced estimates of loan guarantee coefficients that differed little from those displayed in Table 4. Taken together, the results in Tables 4 and 5 indicate that non-guaranteed loans to SMEs rose by more than the additional guaranteed SME loans. The results also indicate that loans to large borrowers, which did not have access to the loan guarantees, also may have risen considerably when the supply of loan guarantees to SMEs rose.

Results for Regional Banks

Table 6 presents the IV-based results of estimating the fixed-effects specification using data only for regional banks. Columns 1-3 of row 1 show that, for the full sample period, SME loans were more and more significantly affected by guarantees on SME loans than larger loans were. But, for the later subperiod, SME loans were not significantly affected at the 5 percent level of significance. On the other hand, loans to larger borrowers were significantly higher during the later subperiod, when CG was larger. In both the full and in the later subperiod, the estimated coefficients on total loans were consistently less than one, indicating that total loans rose by less than the increase in guaranteed loans, which would be consistent with regional banks having at least partially substituted guaranteed for non-guaranteed loans, as has been widely suggested. In that regard, the estimates in Table 6 suggest that additional loan guarantees raised total lending, but by less than the increase in guaranteed loans, supporting the suggestion that regional banks substituted guaranteed for non-guaranteed assets.

The estimated effects of *EQCAPLEV* for the full sample period indicate that loans to SMEs were raised by about ½ as much as capital, a magnitude that was similar to the effect of CG for SME loans during the full sample period. (The absence of capital injections by the government into any but the most-troubled of regional banks precluded our estimating the effects of *CAPINJECT* on regional banks.) One possible explanation might be that overall reductions in regional banks' capital in the late 1990s reduced lending, especially to SMEs as shown in column 2 for the full period, but that neither capital increases nor decreases affected lending in the later subperiod. A more likely explanation is that a number of the weaker regional banks switched from being subject to

the Basel standard to being subject to the much lower, domestic bank standard, which had a capital requirement that was ½ that of the Basel standard. It may be that the reduction in required capital allowed the switching banks to both hold less capital and raise their lending, thereby diluting the positive connection between capital and lending that appeared statistically-strongly in the early subperiod.

As is the case for city banks, loans at regional banks showed no consistent association with banks' Basel status. Regional banks did seem to have fewer loans to larger borrowers when they had more payouts from the loan guarantee agency on their defaulted SME loans. On the other hand, regional banks tended to extend more total, and particularly SME, loans when they had higher prefecture-level economic activity, as measured by *GDP*. Somewhat surprisingly, increases in the prices of commercial land, which was often used as loan collateral, tended, if anything, to be inversely correlated with total business loans. (This was not very surprising in light of prior studies, but still a bit unexpected.)

The overall picture that emerges from the results based on regional banks is one of partial (about 50/50) "substitution" of guaranteed for non-guaranteed loans, in contrast to the "complementarity" of guaranteed and non-guaranteed loans at city banks, where we found that both total and non-guaranteed loans rose considerably at banks where guaranteed loans were higher.

VI. Time-Varying Effectiveness of Loan Guarantees

The estimated effects of loan guarantees on lending at city banks are considerably larger than those estimated for regional banks. Table 4 shows that total loans were associated with about 3 more units per additional unit of guaranteed (SME) loans at city

banks, while Table 6 shows that total loans were about ½ unit higher per additional unit of guaranteed loans. Stated equivalently but more strikingly, guaranteed loans raised non-guaranteed loans by about 2 (3-1) units, while they lowered them by about ½ (1/2 – 1) at regional banks. Based on the later subperiod, non-guaranteed loans rose by about 6 units per additional unit of guaranteed loans at city banks.

How much of the difference across bank categories and across time and conditions can the model laid out above account for? Tables 7 and 8 help answer those questions. (Figures 10 and 11 depict many of these same implications of the model.) Tables 7 and 8 show the marginal effects of an additional unit of guaranteed loans for various assumed levels of gross project returns (R), of market-value equity (e), of the share of loans that are guaranteed (g), and of the percent of the market value of assets that is sacrificed due to liquidation (delta).

Consider first the case when g = 15 percent and delta = 0.05. (15 percent is about the amount of loans guaranteed by the time that the SCGP was fully implemented.) In the case where the gross return, R, is 0.95, the top panel of Table 7 shows that the model implies that the effect of g on non-guaranteed loans is -0.66, which is very close to the estimates shown in Table 6. The top panel also shows that the estimated effects rise rather substantially when net worth is lower (e.g., e = -0.10) or when R is higher (e.g., R = 1.05).

The bottom panel of Table 7 shows similar implied effects when g is lower (e.g., g = 0.10): The estimated effect on non-guaranteed loans is -0.74. Thus, given the observed levels of g and the assumed values of gross returns and of liquidation costs, Table 7 shows that “asset substitution” of the magnitude estimated in Table 6 are indeed reasonable. Had gross return been sufficiently higher and the market value of the equity

of their borrowers been sufficiently lower, regional banks might well have not substituted assets, but instead complemented guaranteed loans with additional non-guaranteed loans.

Table 8 shows how the model might account for the much larger estimated effects at city banks. Consider the case where R = 1.05 and g = 0.10, which is closer to the observed g for city banks, which held proportionally fewer guaranteed loans than regional banks did. Consider also the case where e = -10, that is where the borrowers were seriously insolvent on a market value basis. Such borrowers might fit into the category of the "walking dead," the zombie borrowers who were deeply insolvent but still borrowing from their city banks. Given low enough liquidation costs (delta = 0.02 or 0.03), Table 8 shows that the model implies that the effect on an additional unit of guaranteed lending would, for a bank that kept its LGD unchanged after both guaranteed and non-guaranteed loans were granted to zombie borrowers, raise non-guaranteed lending by about 3-5 units, which is a range similar to that shown in Tables 4 and 5. Thus, the model plausibly, if not incontrovertibly, implies effects in the range of those that we estimated.

Tables 7 and 8 also show that the model might well account for much of the increase in the estimated effect of g that we showed in Tables 4 and 5 as the sample was weighted more toward the later period when borrowers were more financially distressed. (Note that the payout ratio of the loan guarantee agency rose from about 1.4% of guarantees in 1997 to about 3.8% by 2002.) Tables 7 and 8 indicate that the model-implied effect might well rise by two or more units as borrowers sank deeper into insolvency. In that light, the model might account for about ½ of the estimated increase in the effect of g from 3 to 7 that we showed in Table 4. Thus, while the model might not

account for all of the estimated increase in the effect of g, it does account for a large portion of it and in that regard could be termed at least partially successful.

VII. Summary and Conclusions

Many Japanese banks and borrowers were in dire straits in the late 1990s. Actual and potential insolvency plagued both borrowers and banks. To alleviate the contractionary pressures of this financial distress on both banks and borrowers, the Japanese government dramatically increased the supply of guarantees for bank loans made to small and medium-sized enterprises. In much the same way that a government's deposit guarantees can be viewed as providing support indirectly to banks, so do loan guarantees. In fact, the original Merton (1977) article that analyzed the value of deposit guarantees also contained "loan guarantees" in its analysis (and title). In addition to the risk-shifting aspects of loan guarantees that Merton highlighted, we note that loan guarantees, given the lower capital requirements for guaranteed loans, further added to banks' effective capital.

At the same time that it increased its supply of loan guarantees, the Japanese government also made large capital injections into banks, which directly supported banks and added capital that counted toward regulatory standards.

Our empirical results suggest that the "synthetic capital" contributed by loan guarantees had considerably more stimulative effect on bank lending than the "actual capital" that the government provided to Japanese banks. Our estimates imply that, at city banks, loan guarantees increased both banks' guaranteed and their non-guaranteed lending. In that regard, loan guarantees acted as a complement to non-guaranteed loans. In contrast, at regional banks, guaranteed loans acted as if they were substitutes for non-

guaranteed loans.

Our estimates parallel those reported elsewhere for U.S. banks and their lending. Like Hancock, Peek, and Wilcox (2006), we find that government loan guarantees seemed to act like “high-powered capital,” albeit synthetic capital, in that the increases in total loans were a substantial multiple of the increases in guaranteed loans. Thus, our estimates suggest that the Japanese government’s efforts did stimulate lending, which in turn presumably did stimulate overall economic activity. How much the Japanese economy more broadly benefited from these efforts and whether the efforts should have been sooner or larger, or both, is beyond the scope of our study. But, on the narrower issue of whether such efforts at least had their intended, more-direct, and sizable effects, our results suggest that the Japanese government’s injections of synthetic capital did provide substantial stimulus to bank lending at city banks.

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Appendix:
Extending the Model to Include Collateralized Loans

l^{coll}: collateralized loans 40

l^{unoll} : uncollateralized loans 40

α: recovery ratio of collateralized loans $\alpha \in [0,1]$

$$LGD = l^{coll} + l^{uncoll} + g - g - \alpha l^{coll} - \left(a + Rg - \alpha l^{coll}\right)(1-\delta)\frac{(1-\alpha)l^{coll} + l^{uncoll}}{(1-\alpha)l^{coll} + l^{uncoll} + g}$$

$$= (1-\alpha)l^{coll} + l^{uncoll} - \left((1-\alpha)l^{coll} + l^{uncoll} + e + Rg\right)(1-\delta)\frac{(1-\alpha)l^{coll} + l^{uncoll}}{(1-\alpha)l^{coll} + l^{uncoll} + g}$$

If $\alpha = 1,$ then

$$LGD = l^{uncoll} - \left(l^{uncoll} + e + Rg\right)(1-\delta)\frac{l^{uncoll}}{l^{uncoll} + g}$$

This is exactly the same form as Esq. 2)
Thus, when collateralized loans are used, this situation corresponds to the case of small loan size, resulting in a smaller coefficient than the benchmark case in the text.

Generally, if we define $L \equiv (1-\alpha)l^{coll} + l^{uncoll}$, then

$$LGD = L - (L + e + Rg)(1-\delta)\frac{L}{L+g}$$

Again, this is the same form as Esq. 2).
Note that

$$\frac{dl^{uncoll}}{dg}\Big|_{l^{coll},\, g\ given} = \frac{dl^{uncoll}}{dL}\frac{dL}{dg}\Big|_{l^{coll},\, g\ given} = \frac{dL}{dg}\Big|_{l^{coll},\, g\ given}$$

Thus,

$$\frac{dl^{uncoll}}{dg}\Big|_{dLGD=0} = \frac{(1-\delta)\left[\left\{(1-\alpha)l^{coll} + l^{uncoll}\right\}^2 (R-1) - e\left\{(1-\alpha)l^{coll} + l^{uncoll}\right\}\right]}{\left[\left\{(1-\alpha)l^{coll} + l^{uncoll}\right\}^2 + 2g\left\{(1-\alpha)l^{coll} + l^{uncoll}\right\}\right]\{1-(1-\delta)\} + g^2 - (1-\delta)(e+Rg)g}$$

Despite its additional terms, this expression is the quite similar to the case without collateralized loans.

Figure 1
Total Loans

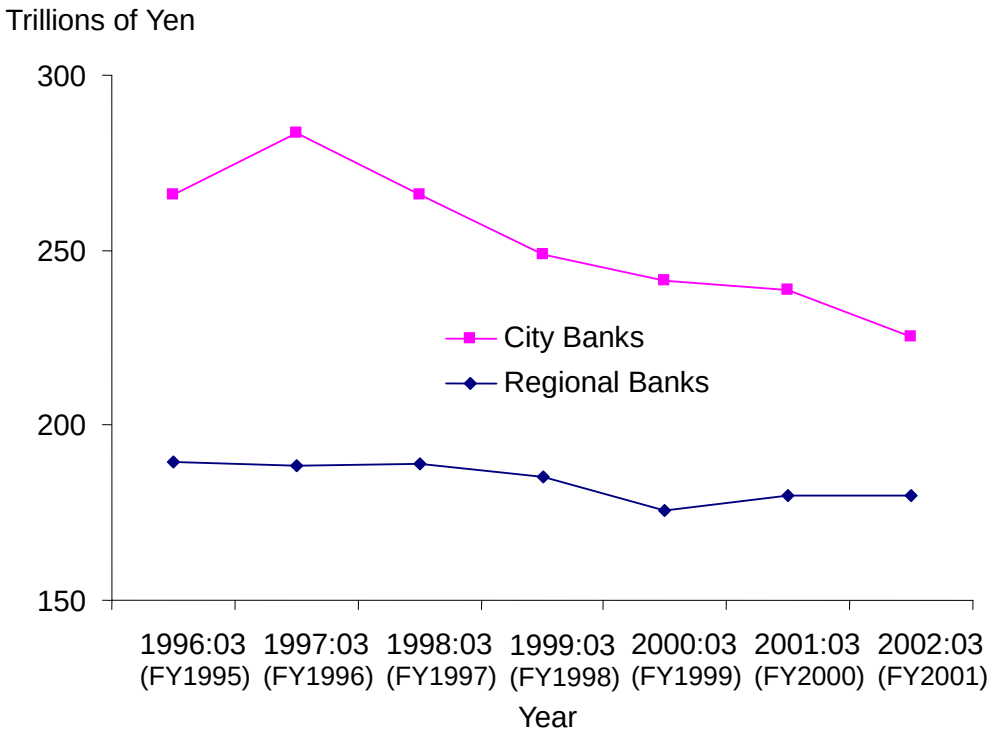

Figure 2
Loans Made to Small and Medium-Size Enterprises (SMEs)

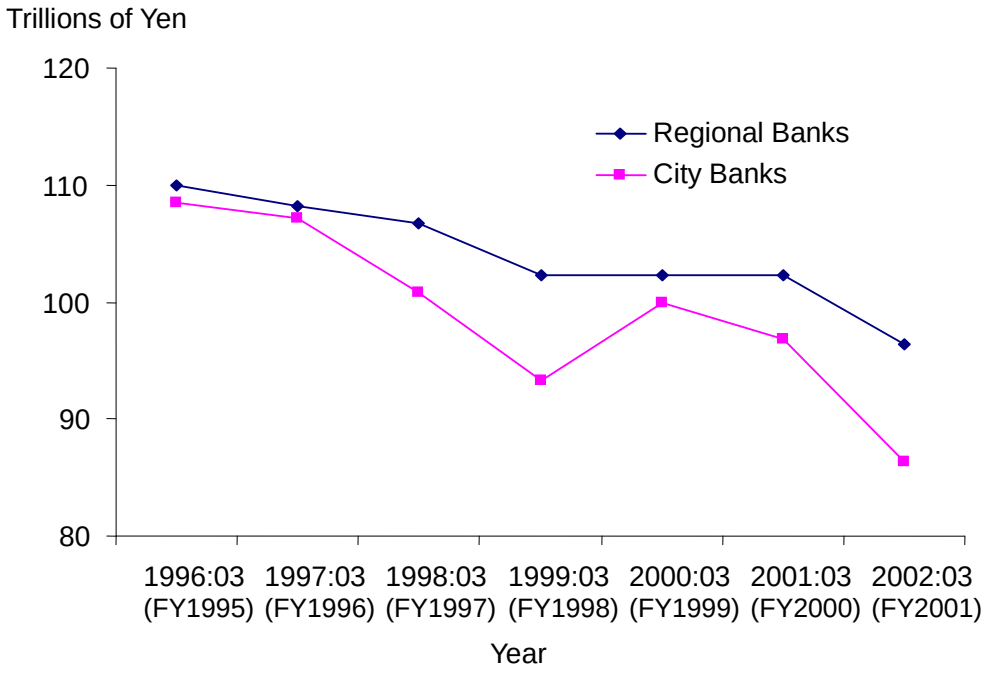

Figure 3
Loans Made to Large Businesses

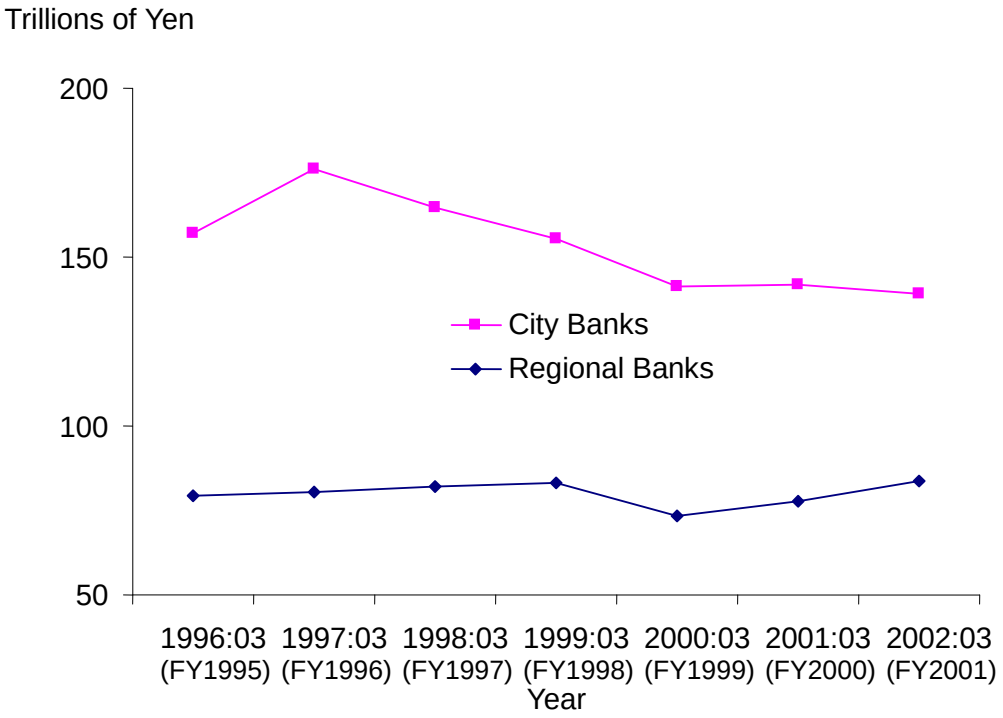

Figure 4
Outstanding Balances of Guaranteed SME Loans

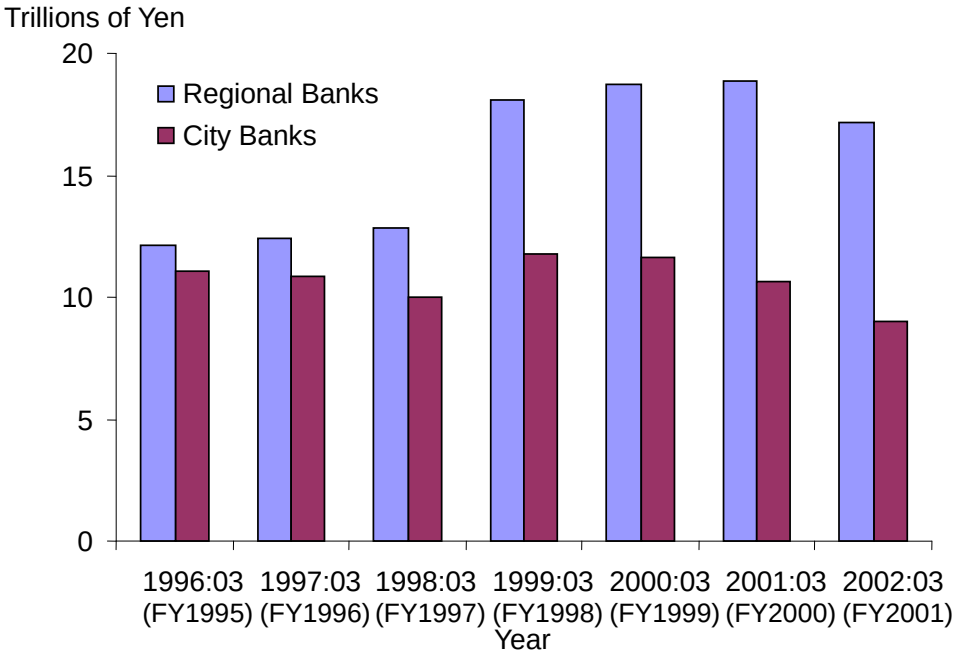

Figure 5
Ratio of Guaranteed to Total SME Loan Balances

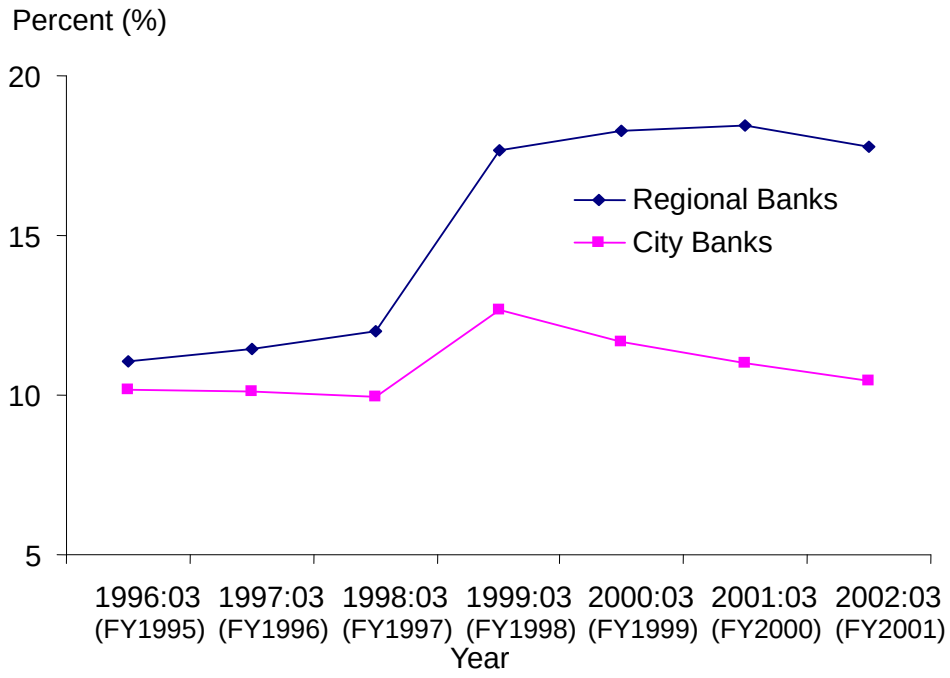

Figure 6
Japanese Banks' Average Equity Capital to Total Assets Ratio

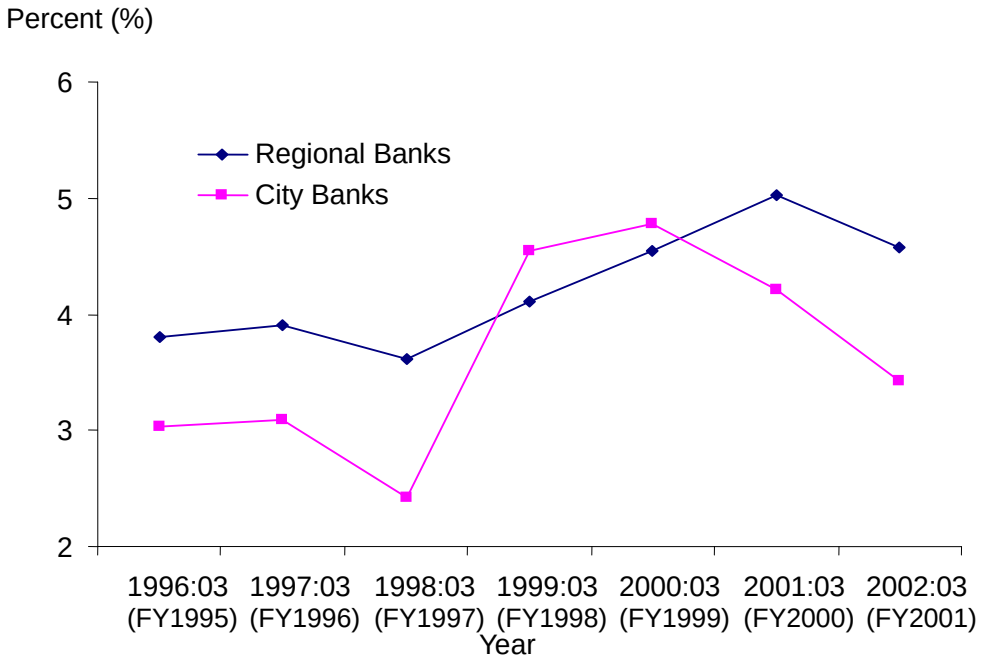

Figure 7
Ratio of Loan Guarantee Payouts to Guaranteed Loans

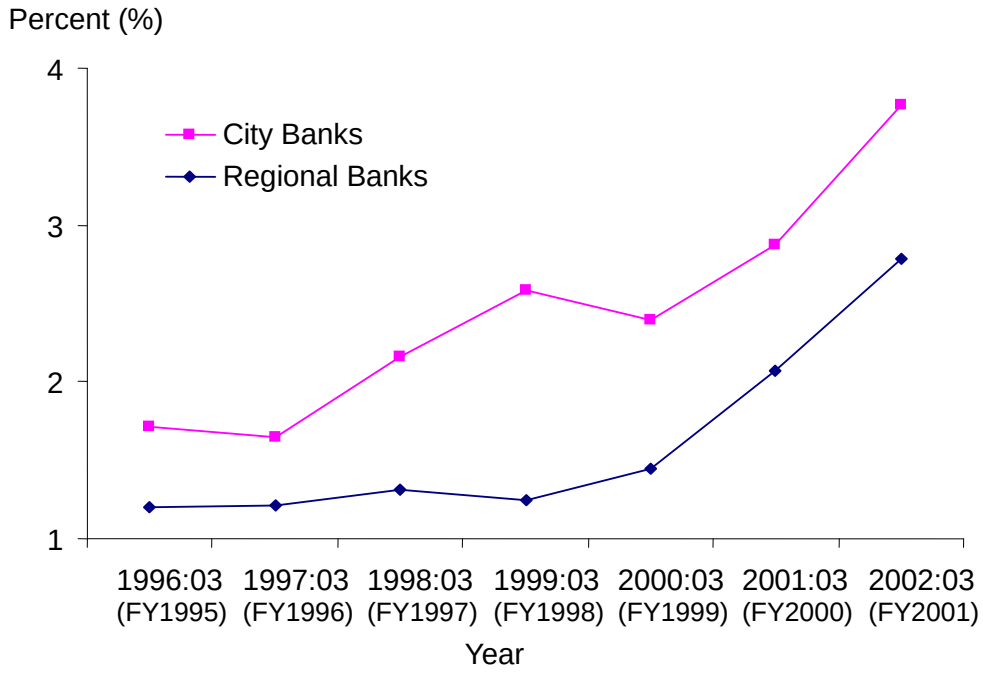

Figure 8
Ratio of Publicly-Injected Bank Capital to Total Assets at All City Banks

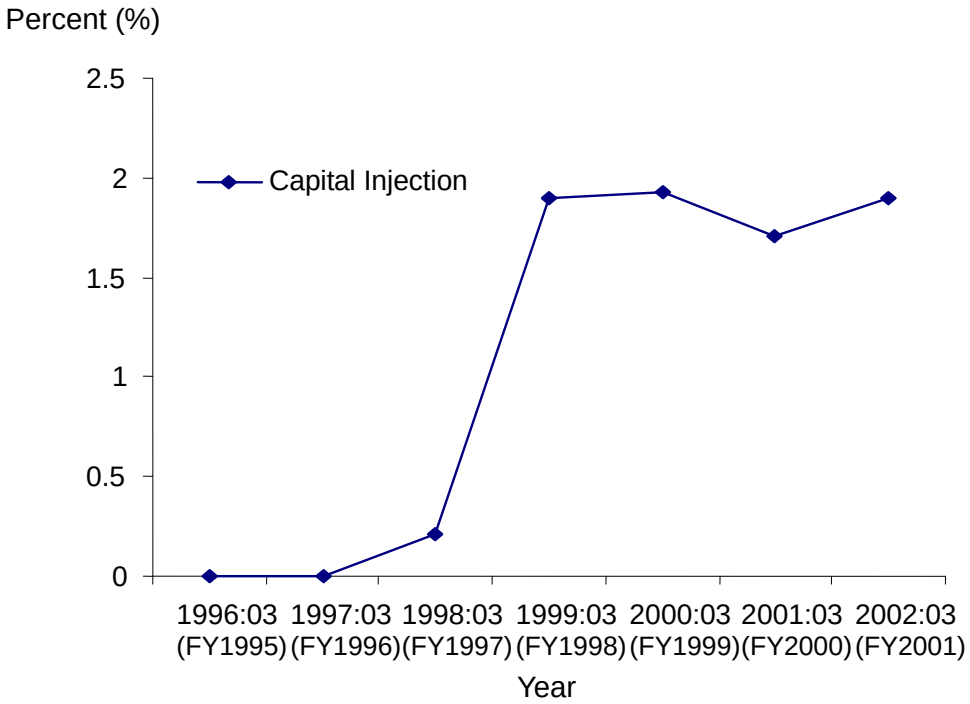

Figure 9-B
A Simple Example of LGD Based on a Borrower's Balance Sheet:
Before a Guaranteed Loan

Assets		Liabilities	
Assets (a)	70	Liabilities (l)	80
		Equity (e)	-10
Total	70	Total	70

Loss (to Bank) Given Default (of Borrower) =80-70=10

Figure 9-A
A Simple Example of LGD Based in a Borrower's Balance Sheet:
After a Guaranteed Loan

Assets		Liabilities	
Assets (a)	70	Liabilities (l)	80
Project Gross Return (Rg)	10.5	Guranteed Loan (g)	10
		Equity (e)	-9.5
Total	80.5	Total	80.5

Loss (to Bank) Given Default (of Borrower) = $80+10-10-(80.5)\left(\frac{80}{80+10}\right)=8.44$

Figure 10
Increases in Non-Guaranteed Loans, per Additional Guaranteed Loans, Rise as Borrowers' Net Worth (e) Declines

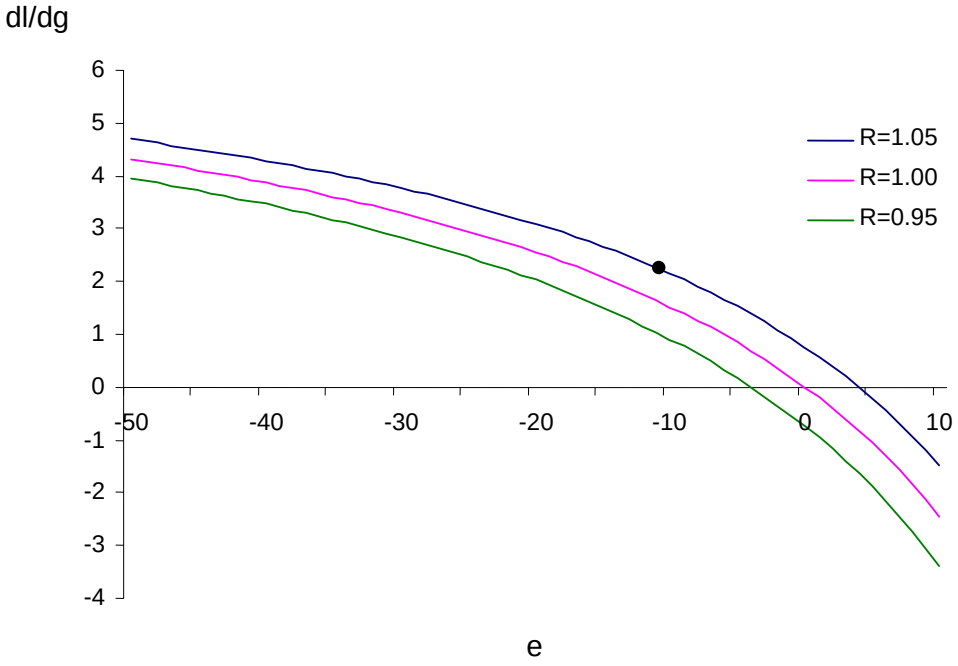

Figure 11
Increases in Non-guaranteed Loans, per Additional Guaranteed Loans, Fall as Borrowers' Guaranteed Loans (g) Rise

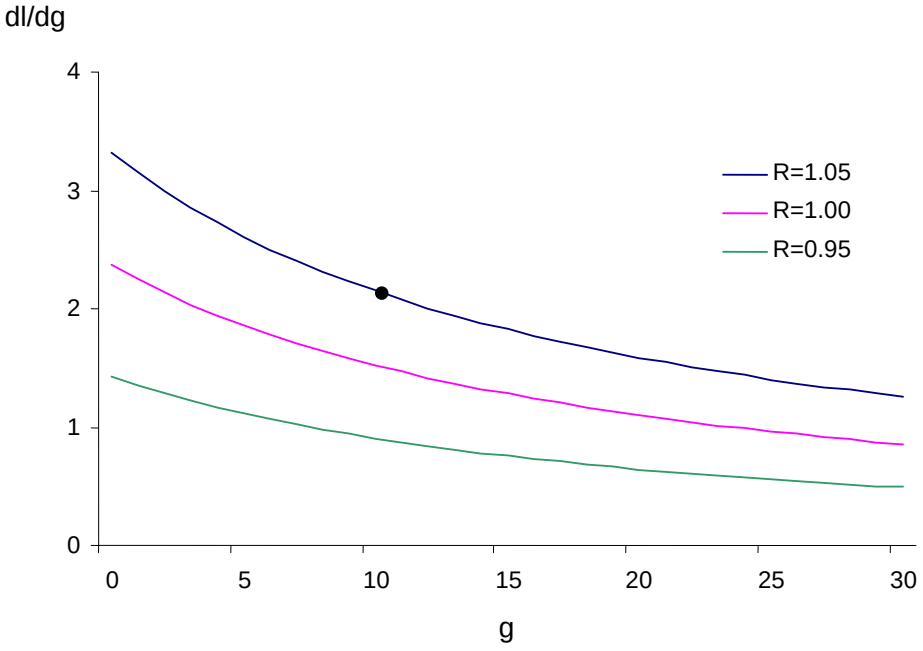

Figure 12
Amounts of the Legislated Cap on the Special Credit Guarantee Program (SCGP) and Two Measures (IV0 and IV1) of Exogenous Amounts of Guarantees Supplied

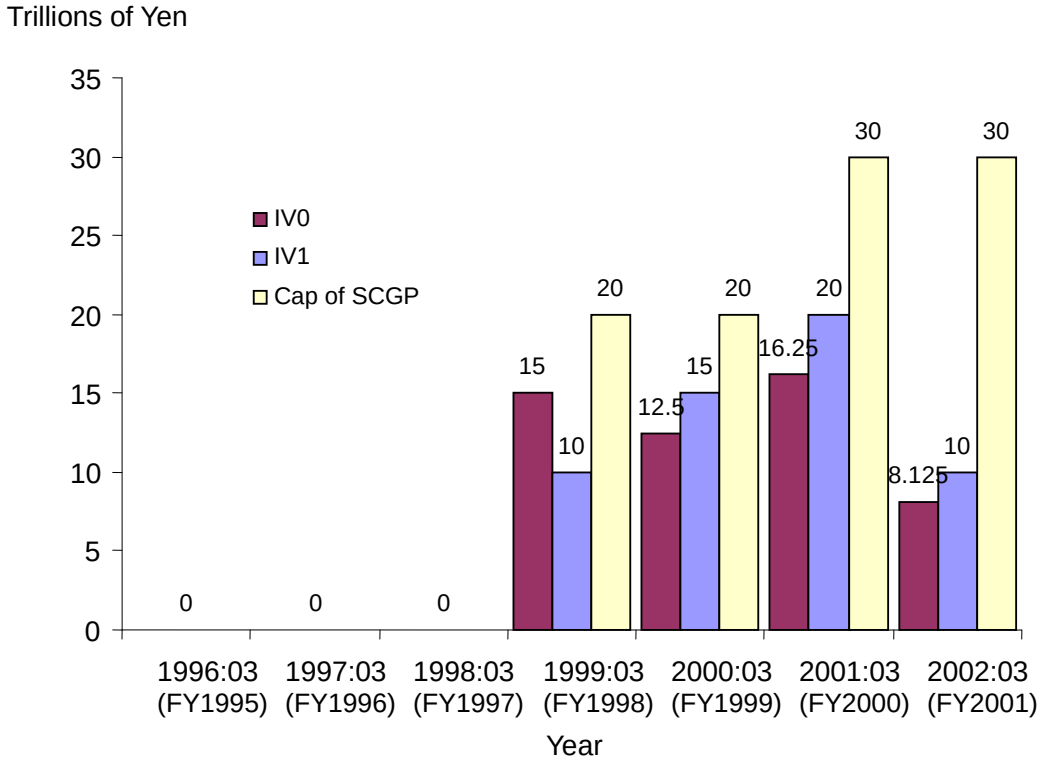

Table1
Descriptive statistics: City banks

		1996:03-2002:03 (FY1995-2001) N=63	1996:03-1998:03 (FY1995-1997) N=29	1999:03-2002:03 (FY1998-2001) N=34	Test Statistics	
		(1)	(2)	(3)	(4)	
0	Assets(trillion yen)					
	Mean	45.2	43.6	46.5	0.6	
	Standard deviation	19.1	18.6	19.8		
1	Total Loans (%)					
	Mean	63.6	65.6	62.0	-2.5	**
	Standard deviation	6.0	4.6	6.6		
2	Small Loans (%)					
	Mean	26.0	26.7	25.5	-0.9	
	Standard deviation	5.0	4.5	5.5		
3	Large Loans (%)					
	Mean	37.6	38.9	36.5	-2.2	**
	Standard deviation	4.6	3.9	4.8		
4	CG (%)					
	Mean	2.9	2.7	3.08	1.5	
	Standard deviation	1.1	0.9	1.2		
5	EQCAPLEV (%)					
	Mean	3.7	2.8	4.44	9.5	***
	Standard deviation	1.1	0.4	0.9		
6	PG (%)					
	Mean	0.07	0.05	0.09	5.7	***
	Standard deviation	0.03	0.02	0.03		

N is the number of observations (bank-years). Test statistics are t-tests for difference of means. % denotes percent of total assets. *** Significant at the 1% level. ** Significant at the 5% level.

Table 2
Descriptive statistics: Regional banks

		1996:03-2002:03 (FY1995-2001) N=854	1996:03-1998:03 (FY1995-1997) N=380	1999-2002 (FY1998-2001) N=474	Test Statistics	
		(1)	(2)	(3)	(4)	
0	Assets(trillion yen)					
	Mean	2.2	2.1	2.2	0.7	
	Standard deviation	1.92	1.9	1.9		
1	Total Loans (%)					
	Mean	70.8	71.7	70.1	-4.0	***
	Standard deviation	6.0	5.9	6.1		
2	Small Loans (%)					
	Mean	42.5	43.6	41.6	-4.0	***
	Standard deviation	7.5	7.1	7.7		
3	Large Loans (%)					
	Mean	28.3	28.1	28.5	1.2	
	Standard deviation	4.6	4.4	4.7		
4	CG (%)					
	Mean	6.7	5.1	8.0	16.5	***
	Standard deviation	3.0	2.0	3.0		
5	EQCAPLEV (%)					
	Mean	4.0	3.6	4.4	10.5	***
	Standard deviation	1.2	1.0	1.2		
6	PG (%)					
	Mean	0.12	0.07	0.16	14.3	***
	Standard deviation	0.11	0.05	0.12		

N is the number of observations (bank-years). Test statistics are t-tests for difference of means. % denotes percent of total assets. *** Significant at the 1% level.

Table 3
Numbers of SMEs, Percent with Guaranteed Loans, Percent of Loans Guaranteed, by Credit Score in Ono (2006) sample

	Total	Credit Scores (better→)					
		<50	50-54	55-59	60-64	65-69	>69
Number of SMEs (percent of SMEs)	7491 (100)	1130 (15.1)	1956 (26.1)	1814 (24.2)	1238 (16.5)	1055 (14.1)	298 (4.0)
Percent of SMEs with guaranteed loans	48.2	77.7	66.3	49.2	29.5	15.7	4.0
Percent of SMEs, by share of loans guaranteed							
0-40%	61.2	51.9	56.6	66.3	76.2	83.7	91.7
40-60%	13.7	13.8	14.9	13.9	11.2	8.4	0
60-100%	14.4	17.4	17.5	12.7	6.6	2.4	0
100%	9.1	15.1	9.5	5.4	4.4	4.2	0

Source: Ono (2006).

Table 4
Effects on Bank Loans of Loan Guarantees, Capital, and Loan Losses
City banks, Fixed-effects (IV/Two-stage Least Squares)

		1997:03-2002:03 (FY1996-2001)			1999:03-2002:03 (FY1998-2001)			1998:03-2002:03 (FY1997-2001)		
	Independent Variable	Total Loans (1)	Small Loans (2)	Large Loans (3)	Total Loans (4)	Small Loans (5)	Large Loans (6)	Total Loans (7)	Small Loans (8)	Large Loans (9)
1	CG	2.906 ***	1.805 *	1.263	7.010 ***	6.688 **	1.384	3.448 **	2.500 **	1.380
		(2.93)	(1.90)	(1.15)	(4.15)	(2.73)	(1.07)	(2.74)	(2.09)	(1.07)
2	EQCAPLEV	-0.152	-1.213 **	1.061	0.588	-0.024	0.785	-0.025	-0.792	0.785
		(-0.24)	(-2.08)	(1.52)	(0.68)	(-0.03)	(1.03)	(-0.03)	(-1.20)	(1.03)
3	BASEL	-0.009	-0.003	-0.005	0.000	0.013	-0.005	-0.007	0.000	-0.005
		(-0.67)	(-0.25)	(-0.36)	(0.01)	(0.69)	(-0.30)	(-0.44)	(-0.04)	(-0.30)
4	CAPINJECT	2.642 ***	3.553 ***	-0.923	1.453	5.339	-0.414	3.188 ***	3.569 ***	-0.414
		(2.85)	(4.19)	(-0.92)	(0.27)	(0.96)	(-0.38)	(2.99)	(3.78)	(-0.38)
5	PG	-22.62	-43.28 **	20.44	-0.319	4.738	9.798	-32.21	-41.27 *	9.798
		(-1.10)	(-2.30)	(0.91)	(-0.01)	(0.13)	(0.39)	(-1.30)	(-1.88)	(0.38)
6	ASSETS (×1million)	-0.007 ***	-0.005 ***	-0.002	-0.006 ***	-0.003	-0.003 *	-0.008 ***	-0.008 ***	-0.003 *
		(-5.52)	(-4.38)	(-1.39)	(-3.31)	(-1.22)	(-1.84)	(-5.28)	(-3.80)	(-1.84)
	F-statistic	35.91	34.34	20.82	37.33	29.15	19.49	30.44	31.48	19.49
	Adiusted R^2	0.95	0.94	0.90	0.95	0.93	0.90	0.95	0.93	0.90
	Observations	50	50	50	32	32	32	41	41	41

Note: Each regression includes year dummies. t-ratios are in parentheses below estimated coefficients.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

Table 5
Effects on Bank Loans of Loan Guarantees, Capital, and Loan Losses
City banks, Fixed-effects (IV/Two-stage Least Squares)

		1997:03-2002:03 (FY1996-2001)			1999:03-2002:03 (FY1998-2001)			1998:03-2002:03 (FY1997-2001)		
	Independent Variable	Total Loans (1)	Small Loans (2)	Large Loans (3)	Total Loans (4)	Small Loans (5)	Large Loans (6)	Total Loans (7)	Small Loans (8)	Large Loans (9)
1	CG	2.918 ***	1.941 *	1.013	6.847 ***	7.841 ***	1.731	3.686 ***	3.254 **	0.856
		(2.88)	(1.88)	(0.97)	(4.31)	(3.71)	(0.76)	(2.72)	(2.45)	(0.61)
2	EQCAPLEV									
3	BASEL									
4	CAPINJECT	2.516 ***	2.373 ***	0.116	0.367	3.307	-3.182	2.812 ***	2.520 ***	0.232
		(3.85)	(3.62)	(0.16)	(0.09)	(0.723)	(-0.66)	(3.58)	(3.38)	(0.29)
5	PG									
6	ASSETS (×1million)	-0.006 ***	-0.004 ***	-0.003 **	-0.007 ***	-0.003	-0.004 **	-0.007 ***	-0.003 ***	-0.003 ***
		(-6.17)	(-3.53)	(-2.36)	(-4.78)	(-1.61)	(-2.10)	(-5.89)	(-3.18)	(-2.77)
	F-statistic	41.99	35.29	24.27	35.75	57.09	18.02	35.42	36.54	24.43
	Adiusted R^2	0.95	0.93	0.90	0.96	0.92	0.89	0.95	0.93	0.90
	Observations	50	50	50	32	32	32	41	41	41

Note: Each regression includes year dummies. t-ratios are in parentheses below estimated coefficients.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

Table 6
Effects on Bank Loans of Loan Guarantees, Capital, and Loan Losses
Regional banks, Fixed-effects (IV/Two-stage Least Squares)

	1997:03-2002:03 (FY1996-2001)			1999:03-2002:03 (FY1998-2001)		
Independent Variable	Total Loans (1)	Small Loans (2)	Large Loans (3)	Total Loans (4)	Small Loans (5)	Large Loans (6)
1 CG	0.526 (3.80) ***	0.606 (3.68) ***	-0.053 (-0.32)	0.033 (0.06)	-1.306 (-1.69) *	2.005 (2.56) **
2 EQCAPLEV	0.529 (4.09) ***	0.443 (2.87) ***	0.088 (0.56)	0.113 (0.75)	-0.086 (-0.38)	0.236 (1.04)
3 BASEL	0.001 (0.33)	0.003 (0.73)	-0.002 (-0.49)	0.030 (3.83) ***	0.019 (1.61)	0.008 (0.68)
4 PG	-1.906 (-1.12)	1.782 (0.87)	3.817 (-1.86) *	0.342 (0.20)	5.858 (2.31) **	-6.112 (-2.36) **
5 GDP	0.003 (3.52) ***	0.003 (2.39) **	0.001 (0.53)	0.011 (5.20) ***	0.009 (2.97) **	0.000 (-0.02)
6 BUSLAND	-0.001 (-2.63) ***	0.000 (-0.09)	-0.001 (-2.06) **	-0.004 (-4.61) ***	-0.002 (-2.01) **	-0.001 (-0.55)
7 ASSETS (×1million)	-0.032 (-7.72) ***	-0.030 (-6.11) ***	-0.002 (-0.39)	-0.087 (-7.52) ***	-0.080 (-4.65) ***	-0.002 (0.10)
F-statistic	50.55	53.32	17.98	51.64	41.83	15.18
Adiusted R^2	0.91	0.91	0.77	0.93	0.91	0.76
Observations	715	715	715	465	465	465

Note: Each regression includes year dummies. t-ratios are in parentheses below estimated coefficinets.
*** Significant at the 1% level.** Significant at the 5% level. * Significant at the 10% level.

Table 7
Model-Implied Effects of Guaranteed Loans on Non-Guaranteed Loans: Changes Implied by Changes in e and in R

g=15, δ=0.05	R=0.95	R=1.05
e=0	-0.66	0.69
e=-10	0.75	1.82

g=10, δ=0.05	R=0.95	R=1.05
e=0	-0.74	0.76
e=-10	0.90	2.15

Table 8
Model-Implied Effects of Guaranteed Loans on Non-Guaranteed Loans: Changes Implied by Changes in e and in Liquidation Cost (delta)

R=1.05, g=10	e=-10	e=-20
δ=0.02	4.30	5.33
δ=0.03	3.24	4.31